



United States Department of the Interior
Bureau of Land Management

Abandoned Mine Land Task Force

November 1996



Abandoned Mine Land Inventory and Remediation *A Status Report to the Director*



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U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Abandoned Mine Land Inventory and Remediation *A Status Report to the Director*

*by the
Bureau of Land Management's
Abandoned Mine Land Task Force*

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Abandoned Mine Land
Inventory and Remediation
A Status Report to the Director

EXECUTIVE SUMMARY

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The Problem

Mining played a significant historic and economic role in the development of the western United States. However, a century of mining on the public lands has left a legacy of numerous abandoned mine sites scattered throughout the West. These abandoned mine lands (AML) pose significant safety and environmental hazards to the public and to ecosystems. Today, the Bureau of Land Management (BLM) faces the challenge of addressing these AML public safety and environmental hazards at a time of limited agency resources, potential budget cuts, and lack of a comprehensive AML inventory of hardrock mining sites.

BLM's Approach

In 1993, the Bureau initiated an inventory of AML on lands managed by the BLM. This report is intended to apprise BLM management of the results of BLM's initial AML inventory protocols, the current status of BLM on-the-ground AML activities, and the need to revise BLM's original inventory strategy.

The BLM AML inventory strategy includes compilation of data from existing sources; development of consistent investigative and documentation methods; initiation of pilot programs to field test procedures and technologies; and development of collaborative partnerships with Federal and State agencies. The strategy was also designed to support related AML activities, such as State AML programs and the Department's subsequent Watershed Cleanup Initiative. While recognizing that an on-the-ground inventory could not be completed for a number of years, the original strategy envisioned the development of a *preliminary* estimate of the number of AML sites on BLM-managed lands by 1997.

Key Findings

Based on existing data, the BLM estimates that there are approximately 70,000 AML sites, encompassing over 300,000 features, on BLM-administered lands. The preliminary estimates presented on a state-by-state basis are discussed in the Findings section of the report. **The reliability and consistency of data across BLM administrative boundaries is poor.** However tentative, the preliminary State estimates provide an initial data base which may be used in planning future inventory and remediation activities.

In addition, BLM has gained valuable insight from the various State pilot programs:

- Numerous AML sites on public lands *pose significant safety and environmental hazards.*

- On-the-ground inventory is critical to accurately locate all AML safety hazards. The BLM pilot efforts found up to three times as many AML features on-the-ground as were indicated from the existing data sources.
- To date, only a small percent of all public lands have been inventoried on-the-ground. However, resources are not, nor are they likely to become, available to complete an on-the-ground inventory of all BLM-managed lands in the foreseeable future.
- Most BLM States have developed good collaborative efforts with other Federal and State agencies. Such partnerships have been instrumental in the progress achieved to date. Partnerships, including those involving private interests and Native American Tribes, will be an integral part of future AML inventory and remediation efforts.
- Continued cooperation and coordination within the Department, other agencies and outside interests is necessary to ensure consistent, comparable and reliable inventory results.
- The remediation of AML hazards is an important land management responsibility.
- The Bureau's AML responsibilities must be weighed against competing agency priorities and budget realities.

During fiscal years 1993 through 1995, BLM AML on-the-ground field inventory, within approximately **7.4 million acres** (less than 3% of all BLM public lands), resulted in identification of approximately **7,000 AML sites** or mined areas which contain over **24,600 individual AML features**. BLM identified **public safety hazards**, such as open shafts and adits, at over **6,600 locations** and **environmental hazards** at almost **900 locations**. The AML inventory also contributed to the abatement of over **500 AML hazards** by BLM and State agencies.

The Solution

The AML Task Force recommends that BLM ...

Focus Field Inventory in Priority Areas

Begin Remediation of High-Priority Safety and Environmental Hazards

Establish a Budget for AML Inventory and Remediation

Inventory and remediation need to continue as BLM program efforts. Future AML inventory and remediation efforts should be focused in State or **local priority areas**, such as high-visititation areas and threatened watersheds. Remediation efforts should be initiated at sites with the most acute public safety and/or environmental hazards. A more focused BLM AML inventory and remediation approach will support the Department's Watershed Cleanup and Western Mine Lands Restoration Partnership activities and allow BLM to play an active role in addressing AML issues through partnerships with the Western Governor's Association, the industry, and the public. The AML Task Force also urges the establishment of a specific budget for AML activities and coordination among all Department of the Interior agencies to develop consistent inventory practices.

CONCERNS

- **Environmental Impact**
- **Physical Hazards**
- **Liability**
- **Land Use Planning**
- **Future Remediation**
- **Duplication of Effort**
- **Lack of Consistent, Accurate Data**

Figure 1. *The BLM's AML inventory and remediation strategy must address a number of concerns.*

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

**Abandoned Mine Land
Inventory and Remediation
*A Status Report to the Director***

I. INTRODUCTION

Over a century of mining activity on the public lands has left a large number of abandoned mine sites scattered throughout the West. These abandoned mine land (AML) sites and their associated mine features pose significant hazards to the public and environment. In 1993, the Bureau of Land Management (BLM) initiated a Bureauwide effort to identify the extent and nature of abandoned mining-related disturbances on the lands it manages. This document is the AML task force's status report to BLM management on the AML inventory effort to date, including results of the State AML pilot programs, findings, successes and problems, remediation efforts, future needs, and recommendations for the future.

Numerous estimates have been attempted to determine the scope of the AML problem. Past studies have estimated the number of sites to be as high as 500,000 throughout the western United States. However, any meaningful discussion of the extent of the problem or the number of potential hazards needs to start with a consistent definition of what is being counted. Previous estimates of the number of AML sites used varying units or definitions of AML sites and thus cannot be meaningfully compared. For example, some estimates were based on the number of features (e.g., shaft, adit or pit), while other estimates counted number of sites (i.e., all features within an individual mining operation or district). Other estimates addressed potential environmental hazards. Even within individual surveys, there have been inconsistencies in the units counted.

The significance of these estimates and any human and environmental hazards is dependent upon the nature of each disturbance and its surrounding environment. Past investigations indicate that while the majority of AML sites pose a relatively low risk, there are a significant number of dangerous sites. The two most compelling areas of concern with past mining activities are safety hazards and environmental hazards. Safety hazards, which pose an immediate risk to humans, livestock and wildlife, include open mine shafts, adits, and pits. Environmental hazards, such as the discharge of acidic waters, generally pose a longer term risk to the environment and other resources.

In both safety and environmental AML hazard situations, the BLM, as a public land manager, faces a rapidly expanding and costly potential liability associated with corrective measures as well as damages or loss of other resource values. The increasing use of public lands for recreational purposes will continue to exacerbate this situation. Safety hazards at AML sites pose an immediate concern to both BLM and the public. Just this summer (1996), two fatalities occurred at an AML site near Virginia City, Nevada when two men entered a mine shaft that contained "bad air."

II. BLM'S STRATEGY

In 1989, the BLM Mining Law Administration Task Force recommended that the BLM conduct an inventory of lands disturbed by locatable minerals mining activities. This recommendation centered on the lack of salient information on reclamation status and potential public safety hazards. In 1993, the BLM established an AML Task Force (Appendix 1) to coordinate AML activities within the Bureau and initiated a systematic Bureauwide inventory to identify abandoned solid mineral¹ mine sites on public lands (Instruction Memorandum No. 93-286). The objective of this effort was to enable BLM to identify, locate, and characterize public-safety and environmental hazards found on the public lands.



Figure 2. Identification of unsafe mine workings is a critical aspect of the BLM's AML strategy.

¹ Locatable, mineral material and nonenergy leasable mineral.

The BLM AML strategy, which relies upon the active participation of field representatives from each BLM State, incorporates consistent Bureauwide inventory standards, databases, and protocols, pilot projects to field test BLM techniques, and initiation of AML inventory actions within each State. Specific guidance was provided on the creation of pre-field and field inventories to ensure a consistent data set across the Bureau. Each BLM State Office was directed to conduct a pre-field review of existing data sources, including literature, data bases, and topographic maps prior to the initiation of field activities. Data from the State Office pre-field reviews, while not a true representation of the extent of AML, has proved to be an excellent first step in identifying areas in need of field verification. The strategy is closely integrated with related AML activities, such as the Department's Watershed Cleanup Initiative and State AML programs, in order to increase efficiency and avoid duplication of effort.

This report summarizes the status of BLM inventory and remediation activities conducted under the strategy. Coordinated activities under the Department's Watershed Cleanup Initiative are discussed in the Colorado and Montana State summaries; however, this report is otherwise limited in scope to the AML inventory and remediation strategy. Summaries of each State's AML activities and the pilot projects are included at the end of this report (Appendix 2). It should be noted that the AML progress by some State agencies is in large part dependent on whether the State has a coal-funded Surface Mining Control and Reclamation Act (SMCRA) program. Western coal States such as Wyoming and Montana have been able to spend SMCRA AML monies on hardrock sites once coal AML is addressed. The non-coal western States have not had such funds available.

The BLM pilot studies, compilation and verification of existing data sources, and development of consistent BLM standards and protocols have all served to increase BLM's understanding of AML on public lands. **Most significant is the sheer magnitude of the problem and the hazards involved.** The AML Task Force has found that, while certain existing data sources are more reliable than others, actual field inventories locate many times more AML features on-the-ground. On-the-ground field work is instrumental in identifying public-safety hazards, many of which are obscured by vegetation or other debris.

"Virtually every site poses a safety hazard." (State AML Coordinator)

Undoubtedly, the statement above over-estimates the risk for all public lands. In Nevada, 55 percent of AML features identified during pilot studies were considered to be potential public-safety hazards. Nationally, potential safety hazards were present at 37 percent of AML features, while potential environmental hazards were identified at 28 percent of the features.

Conversely, the relatively high fiscal and personnel requirements associated with field verification, coupled with a lack of funding and low prioritization by field managers, has limited BLM's progress to date. In the years 1994, 1995 and 1996, BLM spent less than \$1.9 million on AML inventory and characterization, including remediation of public safety hazards (Appendix 3).

"If (BLM State Office) is to participate fully in AML, we need ear-marked funding that has to be applied to AML from the Washington level." (State AML Coordinator)

III. COORDINATION

In addition to pursuing a national strategy to address the AML problem on public lands, BLM actively coordinates with local, State, and national AML initiatives and activities. BLM local and State AML activities, summarized in Appendix 2, rely heavily upon local and State support and participation. For example, in Arizona, BLM has funded field work by the State Mine Inspector office to locate and characterize safety hazards on public lands. BLM-Wyoming and the State of Wyoming have had an AML inventory agreement since 1984. The BLM is developing a good track record as an active participant in AML investigations and activities conducted by State agencies and representatives, the Department, and other Federal agencies. These include:

Western Governors' Association

A 1991 Western Governors' Association (WGA) report reviewed 33 State and Federal AML inventories and related activities. The report concluded that "the findings presented are not comparable among states." The WGA stressed the need to develop some consistency among inventories. The Mine Waste Working Group of the Committee to Develop On-Site Innovative technologies (DOIT) established an AML Inventory Guiding Principles Work Group to evaluate and provide recommendations for enhanced consistency between State and Federal AML activities. The BLM AML task force co-leads are active participants on both WGA groups (Jinx Fox on AML Inventory Guiding Principles and Tom Leshendok on Mine Waste). BLM's AML inventory has assimilated principles and lessons identified by the groups.

Interior's Watershed Cleanup Initiative

Agencies within the Department have coordinated for several years on approaches to cleanup AML on a watershed basis. Participation in this effort includes the Interior land management and scientific agencies, the Department, and the U.S. Forest Service (USFS). Current activities include coordination with the States of Colorado and Montana to develop and fund cleanup activities on a watershed basis. Funding was supplied in the 1997 Appropriations Act in the amount of \$1 million for watershed cleanup activities in the two States. It is important to note, however, that the watershed approach, developed primarily to address water-quality problems associated with AML sites, is not necessarily ideal for addressing public-safety hazards or non-water-related problems at AML sites.

Proposed Western Mine Restoration Partnership

At the annual WGA meeting this past June, the Department proposed a partnership approach to address AML issues in the West. It is envisioned that the partnership, instead of being a new initiative, would instead serve as a coordinating mechanism for the development and promotion of partnerships between organizations, State and Federal agencies, and the public. The WGA is currently evaluating Interior's proposal, as well as those put forth by State agencies and private industry, in order to determine how they interrelate and how each will benefit existing State programs.



Figure 3. *Some of the AML field efforts included the taking and analyzing of water samples.*

General Accounting Office AML Report

General Accounting Office (GAO) Report GAO/RCED-96-30, "Federal Land Management Information Efforts to Inventory Abandoned Hard Rock Mines" was completed on February 23, 1996. The report noted that "no definitive inventory is available of the number of abandoned hard rock mines on federal lands." The report noted BLM's progress under its AML inventory strategy and the overall difficulty of comparing results between previous State and Federal efforts.

Interagency/Tribal Collaboration

The BLM has made partnerships a priority in addressing the AML issue. BLM State Offices have begun collaboration with other Federal, State and local agencies, Native American Tribes, industry, and special interest groups. An example of a coordinated, cooperative effort with a Native American Tribe is a recently-completed effort in Nevada. The BLM conducted an inventory of Paiute Tribal lands within the Pyramid Lake Indian Reservation in Nevada in conjunction with the on-going Statewide AML effort. In 1994, following endorsement from the Tribal Elders, the BLM completed a field inventory with assistance from the Tribal Geologist. The BLM has provided the Tribe and the Bureau of Indian Affairs (BIA) with a report documenting the study findings.

IV. FINDINGS

The preliminary results of the BLM AML field verification and remediation activities through 1995 are summarized in Table 1. In some States, these BLM AML activities were conducted jointly with State and other Federal agencies. Over **6,900 AML sites** were located in the **7.4 million acres**. These AML sites contain approximately **24,600 individual mine features** such as open shafts and adits. **Safety hazards** were identified at over **6,600** locations, and **environmental hazards** were present at **890** locations. **Remediation activities**, consisting primarily of abatement of public safety hazards by State agencies in support of BLM efforts, were accomplished at **537** locations.

Table 1
AML FIELD VERIFICATION AND REMEDIATION²
FISCAL YEARS 1993 - 1995

STATE	ACRES	AML		HAZARDS		REMEDIATED
		Sites	Features	Safety	Environmental	
ALASKA	1,580,000	125			15	2
ARIZONA	385,000	2,427	6,068	701	130	45
CALIFORNIA	28,000	139	312	236		10
COLORADO	3,000,000	2,060		2,380	377	21
IDAHO	50	22	100	33	1	
MONTANA		680		88	63	4
NEVADA	2,080,000	586 ³	8,820	1,600	100	304
NEW MEXICO	159,000	523		1,000	5	150
OREGON	200	206		10	15	1
UTAH	245,800	147		>600	184	
WYOMING	3,800	4		2		
TOTAL	7,481,850	6,919	24,662⁴	6,650	890	537

² Includes State support of BLM AML activities, such as the State of Nevada fencing of shafts located by the BLM on public lands. However, this table does not include State SMCRA programs, Interdepartmental Watershed Initiative or BLM Hazardous Materials (Hazmat) remediation efforts.

³ When delineating sites, Nevada-BLM recognized larger mining areas than did most other States.

⁴ Estimate of field-verified AML features based upon an average of 2.5 features per site for those States which just provided site numbers. This number is probably on the low side; some States reported averages of 3 to 4 features. In Nevada, because of the larger site areas, the ratio of features per site is 15 to 1.

As a result of the BLM AML pilot studies and reviews of AML inventory efforts conducted by other organizations, certain observations and conclusions can be reached.

General Observations

- Instruction Memorandum 93-286 established a 1997 target date for a preliminary estimate of the number of BLM AML sites. However, actual field inventories will take much longer than the initial estimate. Given the magnitude of the task and the fiscal resources committed thus far, it will take years to complete an inventory of all lands managed by the BLM (a 100% field-verified inventory will never be attained).
- On-the-ground inventories, conducted under the 1993 strategy, have common data elements to ensure that AML is characterized consistently. To date, only a small percent (less than 3%) of all public lands have been inventoried on-the-ground with these strategy guidelines.
- The BLM primary field pilot projects were in Nevada and Utah, covering over 2.6 million acres. Nearly 500 AML sites, containing over 2,100 open adits and pits, were located.
 - BLM inventoried over 2 million acres in Nevada, identifying 313 AML sites which contained 8,820 mine features. Approximately 32 percent of those features (1,785) were deemed to be safety and/or environmental hazards.
 - BLM inventoried five mining districts in Utah, comprising over 1,000 square miles. One hundred fifty-six AML sites were located. These contained 362 mine openings and 285 waste dumps. Explosives were identified in 17 locations, underscoring the severity of the AML hazards encountered.
 - During fiscal year 1996, field work in Utah identified 70 AML sites within a proposed off-road-vehicle (ORV) recreation area. Field reconnaissance of the area identified 58 open shafts, adits and inclines, 21 open pits, and numerous other hazardous features. Potential accidents will be averted by routing ORV trails away from these hazards, and by signing, fencing and closing hazardous features in the area.
- Collaborative efforts involving other Federal and State agencies are critical to a successful AML inventory and remediation program. These efforts are excellent opportunities to build Federal, State, private and Native American working relationships.
- Some coal States that have been able to tap Surface Mining Control and Reclamation Act (SMCRA) funds to conduct AML inventories, have conducted inventories in identified problem areas. However, these inventories have focused mainly on safety and only severe environmental concerns.
- The utilization of various high-tech tools, specifically geographic information systems (GIS) and global positioning systems (GPS), improved the accuracy of the inventories.
- In addition, pre-field information sources are a poor method for identifying individual hazardous features. On-the-ground investigations from certain States reveal an average of two to three features per investigated site.

- The BLM's strategy emphasized the use of consistent methods to ensure that inventories report the same information by every Bureau office. The first strategy steps of identifying all available literature and maps produced a very general base inventory. However, the available data sources are not consistent between States and, as a result, the individual BLM State Offices' pre-field inventory methodologies varied. The baseline information generated from this literature, data base and map inventory does provide each BLM State Office with a basis for an estimate of the size of the problem on public lands, and a starting point for addressing AML problems in the field. The estimates on the numbers of AML sites and features based upon existing data sources, are presented in Table 2.

Table 2
ESTIMATED AML SITES AND FEATURES
ON BLM-MANAGED LANDS⁵

STATE	AML SITES	AML FEATURES
ALASKA	6,000	15,000
ARIZONA	22,000	56,000
CALIFORNIA	10,000	29,000
COLORADO	2,500	6,000
IDAHO	400	8,000
MONTANA	1,016	2,500
NEVADA	9,000	165,000
NEW MEXICO	3,000	8,500
OREGON	3,400	8,500
UTAH	10,000	25,000
WYOMING	2,000	8,000
TOTAL	70,816	322,500

⁵ A major difficulty in comparing existing inventory data is the lack of standardization of the units counted. The term 'site' is a subjective unit, generally defined as the land area including all mine-related features associated with a particular mining operation. Individuals could walk the same ground and reach different conclusions as to the extent, location and even number of AML sites. The Task Force proposed using the more easily defined and precise unit 'feature.' A feature is a specific mine-related disturbance, such as a shaft, adit or pit. However, many States continue to count AML sites. Two major factors contribute to this departure. Some States already have well-established State inventories underway; these existing inventories were based, for the most part, on AML sites. In addition, most existing literature and data bases more readily identify sites, not features. The one exception is USGS 7.5' topographic maps; this existing data source was found to be a useful starting point in locating AML features.

The estimates provided in this table are preliminary. Some State features' estimates are calculated from the average number of features found on sites that were field-verified.

- The pilot efforts illustrate that pre-field data sources, including former U.S. Bureau of Mines (USBM) Mineral Industry Location System (MILS) and U.S. Geological Survey (USGS) Mineral Resource Data System (MRDS), are not sufficient as the sole information source for a comprehensive AML inventory. On-the-ground work often identified three or more times as many sites as was identified in the literature, data bases, maps and/or remote sensing.
- The pilot efforts confirmed the need for a common data base and inventory checklist for on-the-ground inventories. The current data base and checklist may need to be reviewed to insure they are compatible with the BLM modernization effort.

Environmental Hazards

- Environmental hazards associated with inactive and abandoned mine sites can have a significant long-term impact on other resource values and uses such as water quality and wildlife habitat. These adverse impacts include chemical releases (e.g., acid-rock drainage), erosion, slope instability and revegetation problems.
- Sites that pose a potential environmental hazard are generally much easier to identify than are those with potential safety hazards. For example, most sites that have the potential for the release of metals associated with acid rock drainage are in areas identified in existing data sources. However, on-site assessments are still needed to verify and accurately characterize the potential chemical hazards.
- Initial field assessments of sites with potential chemical problems may be inaccurate, especially where tailings and dumps are present. Once a potential chemical site has been identified, field examination and testing by experienced professionals with the appropriate knowledge and training should be undertaken. Site characterization is a far more expensive and time-consuming process than simple identification of a potential site.
- A potential environmental hazard is not only determined by presence of a toxic commodity but also influenced by its bioavailability and mobility. Thus, the occurrence of a toxic commodity alone is not enough to quantify the potential hazard.

Safety Hazards

- AML safety hazards on BLM-managed lands are much more numerous than environmental hazards. Safety hazards include open shafts, unstable structures, and flooded pits.
- A critical component of any inventory of AML sites that attempts to identify safety hazards is on-the-ground investigation. Other approaches, including literature and data base searches, remote sensing and aerial observations, are valuable aids in identifying sites with potential safety hazards, but there is no substitute for comprehensive field investigations.
- BLM is refining its cutoff and screening criteria for AML hazards. This is especially needed for safety hazards where the number of reportable features quickly becomes unwieldy. For example, in Nevada it was determined a cutoff was needed to reduce the number of reportable features. In the later stage of the Nevada field work, only mining features greater than one meter deep or those showing a serious safety or environmental hazard were recorded.

- In order to safeguard employees conducting AML inventories, BLM established a policy restricting entry to underground mines, coining the phrase **"Stay out and stay alive."**

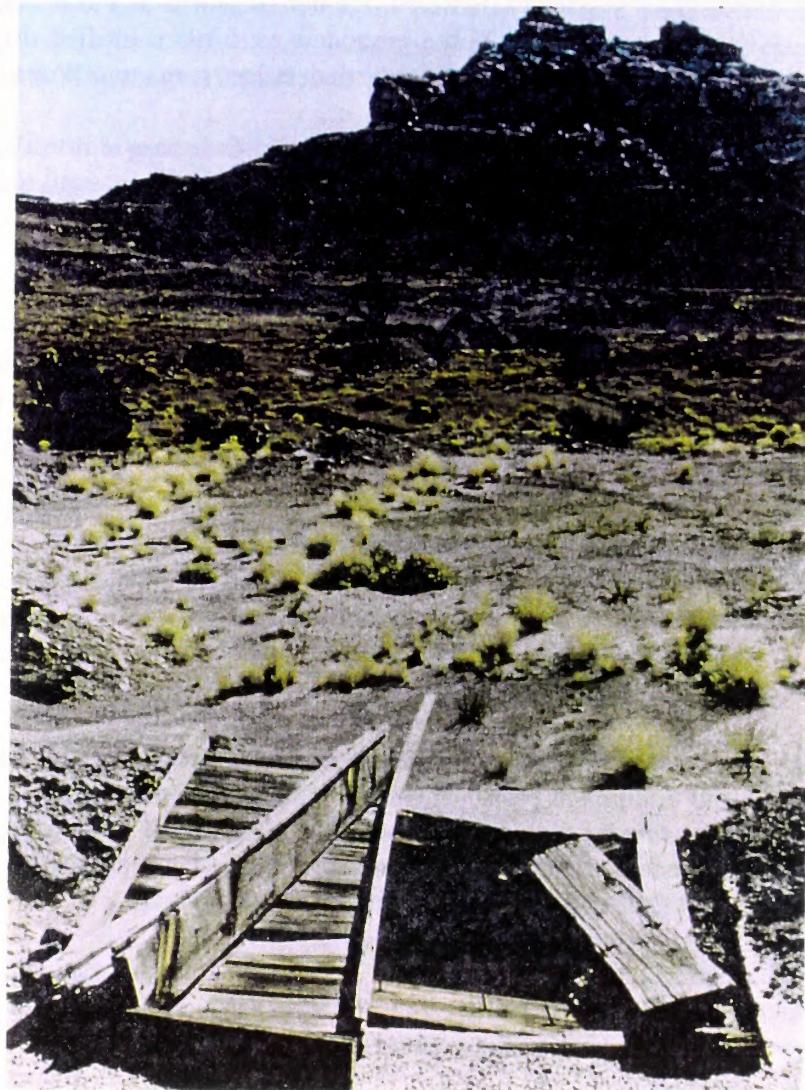


Figure 4. *Potential safety hazards can only be adequately evaluated through an on-the-ground investigation. Alternative investigation techniques, such as data searches and remote sensing, generally do not provide the information needed to identify safety hazards such as this partially-obstructed shaft.*

Wildlife Habitat

- Abandoned mine sites provide critical habitats for candidate and threatened and endangered bat species, and other wildlife, such as the Desert Tortoise.
- BLM, working with Bat Conservation International, and Federal and State agencies, protects at-risk bat populations and their habitat by evaluating abandoned underground mine workings for bat usage prior to closure. Appropriate closure methods, such as bat-friendly grates, are used when underground workings provide roosts for bat populations.

V. REMEDIATION

A number of BLM offices are working to resolve the safety and environmental hazards that have been identified. These efforts have shown that the abatement of safety hazards is generally less costly than remediation of environmental hazards at AML sites. For example, adit closures in Colorado average \$1,000 per closure. In Nevada, where shafts and adits are fenced to prevent accidental entry by the public, wildlife and livestock, the cost is minimal (about \$300 - \$400 per shaft). However, addressing certain safety hazards can be more costly. BLM-Nevada, Carson City District, is currently remediating a major mine opening near a school in Virginia City. This particular remediation effort is expected to cost in excess of \$100,000.

Remediation of environmental hazards may be far more costly. Today's 'worst-case scenario,' the Summitville Mine in Colorado, is costing the EPA \$30,000 per day in operating costs to treat acidic waters with high metals content. The relative costs of remediation or treatment for chemical-type environmental hazards, such as acid-rock drainage, is generally far more costly than abatement of safety hazards or remediation of physical environmental problems such as lack of vegetation, erosion, or slope instability.

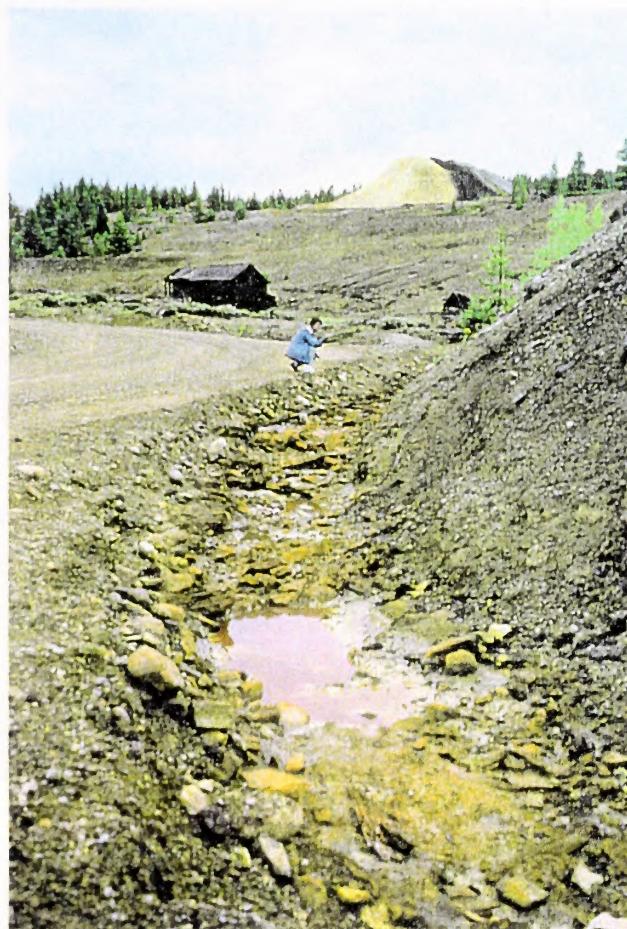


Figure 5. Acid-rock drainage from waste dumps near Leadville, Colorado is one example of the types of environmental hazards that need to be abated.

Past AML safety and environmental remediation efforts have generally been dependent upon State coal AML programs. These initiatives are primarily being funded through available SMCRA funds in the coal States. For example, Utah, New Mexico, Wyoming, Colorado, and Montana are active in pursuing remediation in coordination with State and other Federal agencies. For a more detailed write up, see the discussions for those States in the State AML Programs section of this report.

In the non-coal western states (e.g., Nevada, California, Idaho, Oregon, and Arizona), remediation efforts have been limited due to a lack of funding. However, in Nevada, BLM has entered into a formal memorandum of understanding with the State Division of Minerals. BLM-Nevada identified AML safety hazards in the field, and the State remediated, primarily by fencing, 158 physical abandoned mine-safety hazards on public lands in 1995. In March, Director Dombeck gave a **Health of the Land Award** to the State for those efforts. In another partnership effort, BLM and the State of Utah have jointly developed an extensive "Stay Out and Stay Alive" public awareness campaign.

Remediation of high-priority environmental hazard sites is also ongoing within the BLM's Hazmat program. These efforts are not documented in this report.



Figure 6. *In States without access to SMCRA funds, remediation measures are often limited to simply fencing off safety hazards such as this open shaft.*

VI. INVENTORY AND REMEDIATION OPTIONS

The AML task force recommends that the BLM use this opportunity to reevaluate the original objectives of BLM's AML inventory and consider a revised strategy to meet BLM's management responsibilities given today's fiscal realities. The Task Force presents the following options, including some of the key advantages and disadvantages associated with each strategy.

Option 1: Focus AML Field Inventory and Remediation in Priority Areas

Option 1 will support field efforts to address BLM's most severe AML hazards by focusing inventory and remediation efforts at the highest-priority sites and features.

BLM would complete the preliminary data compilation, based on existing data sources, that systematically estimates the number of AML hazards on public lands administered by the BLM. Decisions concerning field verification and site characterization would then be based on local priority setting that **focuses limited funds on the highest-priority sites, features or areas**. In turn, remediation targets would be established based on priority needs (e.g., safety hazards in high-visitor-use areas).

Option 2: Continue Current AML Inventory

BLM would continue to systematically conduct a pre-field and field inventory of all lands administered by the BLM. The current effort does not explicitly call for the prioritizing of remediation sites/features or the remediation of those hazards.

Option 3: Complete Preliminary Data Compilation; Discontinue Field Activities

The BLM would discontinue any attempt to systematically quantify the true extent of the AML problem on BLM-administered lands. This would include terminating all field efforts with the specific objective of identifying potential public safety and environmental hazards associated with abandoned mine lands. Completion of the preliminary data compilation only, would provide the BLM and public with very rough estimate of the number of AML sites on public lands; however, the data would be of questionable accuracy. Individual BLM States could continue field inventory efforts, but these activities would not be coordinated nationally and would be undertaken mainly in conjunction with other funded activities, such as field inspections of active mines. Funding for the identification, evaluation, and remediation of AML safety hazards in the field would not be available.

Table 3
 INVENTORY AND REMEDIATION OPTIONS
 PROs & CONs

Option 1: Focus AML Field Inventory and Remediation in Priority Areas

PRO	Completion of a pre-field inventory provides an estimate of the magnitude of the AML problem that might exist on BLM-administered lands.
PRO	A completed pre-field inventory aids in targeting field inventory and remediation efforts at the areas of greatest need.
PRO	Allows for greater focusing of limited fiscal resources to address the highest-priority problem areas.
PRO	Focuses funds on the abatement and remediation of AML hazards on the ground.
PRO	Compatible with the Department's Watershed Cleanup Initiative.
PRO	With the emphasis on remediation, a greater number of hazards will be addressed.
PRO	BLM's mandate to preserve, protect and restore the health of the land will be furthered with the abatement and remediation of the most significant safety and environmental hazards.
CON	BLM AML remediation activities involving environmental hazards, even when limited to priority areas, will require a significant funding level. Current funding levels do not support such an effort.

Option 2: Continue Current AML Inventory

PRO	Provides an accurate assessment of the extent, nature and location of AML hazards on public lands.
PRO	Provides a comprehensive inventory upon which remediation decisions could be based.
PRO	Meets all statutory requirements and policy objectives related to the collection of AML information.
CON	Such a comprehensive effort would be time-consuming and very expensive.
CON	Current funding proposals do not support such an effort.
CON	Currently, there is limited management support to continue the current effort.
CON	The current strategy focuses on the inventory, with no emphasis on remediation. Ultimately remediation, not an inventory, is the action that furthers the BLM's mandate to preserve, protect and restore the health of the land .

Option 3: Complete Preliminary Data Compilation; Discontinue Field Activities

PRO	Provides an estimate of potential AML hazards that might exist on BLM-administered lands.
PRO	Would not impose significant additional work or funding obligations; the work is mostly complete.
CON	Would not provide enough information to accurately assess the number, locations, or nature of AML hazards on public lands.
CON	Would not meet BLM's policy objectives and responsibilities for protection of the public and resource values, nor would it satisfy BLM's commitment to identify AML hazards.

VII. RECOMMENDATION

BLM's initial objective of completing a consistent, nationwide, field-verified inventory of all AML sites is unrealistic in today's fiscal climate and will not maximize BLM's use of resources or funding. It is imperative that progress be made towards BLM's ultimate objectives of **ensuring public safety and the health of the land**. Until the focus shifts from inventory to actual remediation of AML sites, there will be little opportunity to further this objective.

The AML Task Force recommends that the Director adopt Option 1, Focus AML Field Inventory and Remediation in Priority Areas. This strategy for the future provides the BLM with the best opportunity for furthering its management objectives and responsibilities within today's budget realities.

The AML Task Force recommends that the Director designate annual funding of \$1 million for the identification and abatement of BLM's most hazardous, high-priority AML sites. A specific budget for AML activities will enable the BLM to address safety and related AML hazards and will complement future Departmental watershed cleanup activities, which are limited to water quality impacts. A successful AML program requires designation of funds specific to AML inventory and remediation activities on the ground. Without such funding, BLM will have to continue to rely on reallocation of funds from other programs. As programmatic budgets continue to decline, it is increasingly difficult for these programs to provide funding support for AML activities. Such a situation will greatly hamper future progress.



Figure 7. A more focused effort will allow the BLM to address the highest-priority safety hazards such as this open adit in high-recreational-use areas.

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In addition, the Task Force would like to thank Paul McNutt for his support in writing, editing and overall development of this report.

Appendix 2

BLM STATE AML PROGRAMS

Alaska

In 1993, BLM-Alaska initiated a pilot AML inventory effort in the Forty Mile Wild and Scenic River area in conjunction with ongoing surface management responsibilities. Pre-field work for the study included a review of all existing data sources (literature, data bases and maps). This review indicated over 200 historic and active mine sites in the study area. All identified sites were placer mines.

During the 1994-1995 field seasons, BLM conducted field investigations on approximately 18,000 square miles of the Scenic River. Of the 200 potential sites identified in the pre-field review, the field teams were only able to verify 125. Many historic placer mining disturbances in and along waterways in Alaska have been obliterated by years of ice buildup and flooding. The majority of the identified sites consisted of nothing more than the partial remains of old buildings. Water samples, including a check for heavy metals, were taken at all identified sites. No unusual levels were found at any of the sites. However, 15 sites were identified as having potential fuel leaks from abandoned equipment. During 1995, two sites were remediated by authorizing a mineral material sale that stipulated cleanup of the site as part of the sale.

In 1996, BLM-Alaska conducted a complete search of existing data sources for the Steese-White Mountain area. Field verification of the identified sites are conducted as part of ongoing surface management (43 CFR 3809) field inspections. As was the case in past field efforts, BLM-Alaska will continue to take water samples at all identified sites.

To date, the BLM has not conducted a complete preliminary evaluation for all BLM-administered lands in Alaska. However, based on existing data searches, including recently-completed field results, the BLM estimates there are approximately 6,000 AML sites on BLM-administered lands in Alaska. It is anticipated a systematic pre-field data review will be complete by 1998. Abandoned mines in Alaska are atypical in that the majority consist of relatively benign, small-scale surface placer disturbances. As is the case for 1996, future field verifications will be conducted as part of routine surface management inspections. Work on the AML data search in Alaska is currently being performed as part of the normal duties for Mining Law-funded personnel.

Arizona

Based on a review of existing literature, data base and maps, BLM-Arizona has identified 23,190 potential AML sites/features on BLM-administered lands within the State. The review, which is over 90 percent complete, covers approximately 105,000 square miles of public lands.

To date, 601 sections or approximately 385,000 acres have been field-verified by the BLM and the Arizona State Mine Inspector. This field work, which has covered about ten percent of the BLM-managed lands within the State, has identified 6,068 AML features, of which 4,144 features or 68 percent were not previously identified in the pre-field review. Of these field-verified features, 701 (12%) were significant safety hazards, while another 130 (2%) are potential environmental hazards. BLM and State field crews investigating these AML sites are finding an average of two-and-a-half features (shafts, adits and pits) per site.

The BLM, in cooperation with the State of Arizona, has undertaken remediation measures on a few features. To date, the State fenced and posted 45 features, at a cost of \$300 to \$400 per feature. In addition, the BLM backfilled 16 safety hazard features. The BLM and State routinely post signs on most sites determined to be a public-safety hazard.



Figure 8. Concerns with structures associated with historic mining activities are also being addressed in cooperation with State and other Federal agencies.

BLM-Arizona has an agreement with the Arizona State Mine Inspector's Office to coordinate field reconnaissance work related to inactive and abandoned mines. In 1996, BLM continued to work with the State conducting its field inventories. In addition, BLM-Arizona will be working with the State and other Federal land management agencies to establish a Statewide GIS system to record AML data. Also in 1996, the BLM cooperated with the NPS in the remediation of abandoned mine lands in the Fort Bowie National Historic Park and adjoining public lands.



Figure 9. Some AML features, such as this open pit, have become a dump. Such misuses of the public's land creates nuisances and potential public and environmental hazards.

California

The literature search (primarily the former USBM's MILS) for the entire State identified 7,810 AML sites on BLM-administered lands. However, cross checks with other sources (i.e., USGS's MRDS, USGS 7.5' topographic maps, and a pilot field project conducted in 1995) indicates that the USBM data base reports only 68 percent of the AML sites identified from all sources. Based on these very preliminary numbers, BLM-California estimates there are 11,500 AML sites on BLM-managed lands in California. This estimate is for sites which may include one or more features (shafts, adits, waste piles, trenches, etc.). Of these, only about 6,000 or fewer sites might be public-safety hazards, and considerably fewer are likely to originate environmental damage (e.g. acid-rock drainage).



Figure 10. Field inventories conducted by BLM-California have identified 236 safety hazards, including this open shaft in the California Desert District near Barstow, California.

Field inventories that have been conducted by the BLM in California are incomplete and have not followed a systematic approach. Although all BLM resource areas have gathered some AML information over the years, no standard inventorying procedures have been employed. The one exception is the recently-completed pilot project. This effort involved field-intensive investigation of two 7.5' quadrangles in the Bishop Resource Area. The pilot project involved field reconnaissance of 28,800 acres (45 sections) and identified 121 features (20 shafts and adits, 101 small surface excavations and pits) in 27 sites. To date, none of these features have been remediated.

Since 1990, the Caliente Resource Area has been the most active in documenting its AML problem. The Resource Area identified 199 sites based on pre-field information. Field inspections have verified 112 sites, containing 61 open shafts and 130 adits. In an effort to mitigate potential safety hazards, three of the shafts have been fenced. In the Barstow Resource Area, 18 shafts and seven adits have been documented thus far. The BLM has fenced seven of the shafts and has placed a high priority on the closure of one shaft that poses a public-safety hazard. Many more sites have yet to be addressed. For 1996, BLM-California proposed each Resource Area conduct a minimum AML field inventory covering two 7.5' quadrangles. As proposed, each Resource Area will follow procedures utilized in the 1995 pilot project, including the use of the "California AML Inventory Checklist and Data Form."

The State of California lacks a coordinated effort focused on the identification and remediation of potentially hazardous AML sites. As such, BLM has not been able to establish a strong Federal/State partnership in this effort. BLM-California has, however, met with other Federal agencies, California State Department of Toxic Substance Control and California State Department of Water Resources on this issue. At the local level, BLM resource area personnel have established contacts with the appropriate county officials.

Colorado

BLM-Colorado has had an active AML inventory program since 1993. They have looked at every opportunity to coordinate and cooperate with other Federal, State, private and academic organizations in meeting their information and inventory needs. As a result of this committed effort, Colorado estimates that 75 to 80 percent of all public lands in the State have now been inventoried.



Figure 11. An unstable mine building near Hancock, Colorado; one of the many hazardous features to be found on the estimated 70,000 potentially hazardous AML sites on public lands.

Pre-field investigation of target study areas have generally relied upon published and unpublished documents, and various Federal and State data sources, including data bases and topographic maps. However, on-the-ground investigations have revealed the existence of many more sites than were initially indicated from the literature, data bases and maps. Based on existing data sources, including recently-completed field results, BLM-Colorado estimates there are 2,500 AML sites on BLM-administered lands within the State.

To date, field inventories have been conducted on three million acres, covering 371 7.5' quadrangles. Colorado has documented 2,060 inactive or abandoned mine sites on public lands. Of those documented sites, 952 sites contained safety hazards, while 151 have been identified as potential environmental-hazard sites. It should be noted, each site may contain multiple features that may be a hazard. In fact, most of the 952 hazardous sites have multiple (2-3/site) safety hazards. In general, safety hazards in Colorado consist of open shafts, adits, and stopes, while environmental hazards are typically acid-rock drainage and contaminated runoff. Much of the field work in the past few years has been handled by the USBM, seasonal BLM employees or by contract. However, budgets for 1996 are not adequate to contract work for additional AML inventorying. Additional 1996 AML field investigations were handled by existing BLM staff, plus the aide of three seasonals. It is anticipated that a survey of the remaining uninventoried BLM-administered lands should be completed by 1997.

BLM-Colorado has implemented several watershed remediation efforts in support of the Department's Watershed Cleanup activities. These ongoing collaborative efforts include a number of Federal, State and private parties, including USGS-Water Resource Division, Colorado Water Quality Division, Colorado Division of Minerals and Geology, EPA, Colorado School of Mines, and Upper Animas Stakeholders Association. A joint (BLM, Colorado Water Quality Division, EPA and other Federal land management agencies) watershed prioritization project was recently completed for the State. This effort identified which watersheds in the State were the most severely impacted by past mining and would be the focus of future cleanup efforts. BLM is also involved with site characterization of 15 high-priority sites on public lands, 13 on the Upper Animas River, one on the Arkansas River and one on Kerber Creek. In addition, conceptual design for site remediation is in progress on four AML sites on the Upper Animas.

Since the 1980s, the Colorado Division of Minerals and Geology, Abandoned Mine Land Program has been able to use SMCRA funds to close several hundred safety-hazard sites on public lands. Recently, the BLM and State have been able to close five shafts and 16 adits (one with a bat gate) that were identified by the BLM. The average cost for these most recent remediation efforts has been approximately \$1,000 per closure. In addition to direct on-the-ground involvement with the State on closure activity, the BLM has recently completed the engineering design for closure and mitigation of AML sites on Tenderfoot Mesa in the Grand Junction Resource Area.

Idaho

BLM-Idaho has conducted a Statewide review of all existing AML and related data sources, including the USBM MILS and USGS MRDS. Through a Cooperative Agreement with the Idaho Geological Survey, a data base, and a series of overlays and AutoCad files have been prepared documenting site locations, mineral commodities, and known production on BLM-administered lands in Idaho. Approximately 8,500 mines and prospects are evident in Idaho (without regard to land ownership, activity, or relative weighing of the impact of the site).

Based on a preliminary screening of this data, BLM estimates there are approximately 400 priority AML sites on BLM-administered lands in Idaho that would justify a detailed site inventory and investigation for future remediation possibilities. Approximately 200 of these sites have historic production in excess of 1,000 tons, one criteria used by BLM-Idaho for screening. Other criteria include high-recreational use and other public exposure, and environmental sensitivity. Priority sites are most abundantly clustered in: the Coeur d' Alene Basin "Silver Belt"; the Owyhee Mountains (Silver City/Delamar area); and in the Hailey Gold Belt (near Sun Valley and Fairfield). These numbers are *conservative* and do not include every possible prospect.



Figure 12. *AML hazards do not just apply to the public, as a USBM field crew investigating AML sites for the BLM found out.*

The Idaho Geological Survey agreement also produced detailed mine history reports covering 28 individual mines. Each report is comprehensive and summarizes chronological development of mining at district or site, mining and processing methods, and the extent of workings. These reports have proved valuable as a starting point for field inventories. One voluminous report on the Coeur d' Alene Basin provides details of eight mill and mine sites in the Pine Creek area. This report is being used concurrently with the HazMat assessment of the area for remediation.

The field work for the Minerals District in the Lower Snake River District is essentially complete, and site inventories in the Coeur d' Alene and Shoshone Districts have been initiated. This field work has included reconnaissance-level and detailed field-inventory techniques using BLM's standard field AML inventory forms and use of GPS for mapping and site locations. Hazardous conditions including open adits, shafts, and explosives have been found on several of the sites. Tailings located along streams in Coeur d' Alene and Shoshone Districts are primary environmental hazards. To date, 22 sites have been inventoried, with an average of four features per site. Mine land acreage inventoried is approximately 50 acres. The inventories completed to date indicate a dominance of physical-hazard features over environmental.

In December 1995, the BLM-Idaho Management Team adopted an AML inventory plan that targets completion of an inventory of *priority* AML sites by 1999. In response to the plan, field offices have been in the process of targeting and initiating inventory on priority sites. The success of this plan will depend on future funding, priority relative to other issues in the minerals program, and management support.

BLM Idaho's Hazardous Materials Program has been involved with site assessment and cleanup efforts at abandoned mine sites in Idaho since 1983. Much of this cleanup work has been done through innovative agreements and negotiations with companies and other agencies, with minimal cost to the Federal government. Mine sites with major assessments and cleanup actions include:

<u>Site</u>	<u>Remedial Actions</u>
North Creek Mill	Tailings Removal
Champagne Creek Mine	Acid-Rock-Drainage Treatment
Delamar Mine	Studies of Federal Facilities
Triumph Mine	Remedial Action to begin in 1997
Black Pine Mine	Cyanide Solution Release Mitigation
Princess Blue Ribbon	Removal of Hazardous Materials
Various Sites (Coeur d' Alene Basin)	Numerous Remedial Actions Completed
Mercury Study (Owyhee Mountains)	Sampling for Mercury

Montana

The BLM has been a long-term partner with agencies of the State of Montana in the identification and remediation of AML sites and features within the State. Two major inventorying efforts have been undertaken. The first was a Statewide effort that was completed in 1994 by the Montana Department of State Lands (since reorganized and now the Department of Environmental Quality (DEQ)), Abandoned Mine Reclamation Bureau. The other major inventory, which was completed in 1996, was conducted by the Montana Bureau of Mines and Geology (MBMG).

In response to the requirements of SMCRA, the State established an AML program under the Montana DEQ. The DEQ completed a comprehensive inventory of all AML sites within the State with the intent of identifying and remediating public-safety hazards. The inventory, which identified 6,000 sites, relied on existing data sources, and public and land management agencies' nominations, followed up with field verification. The DEQ, using coal reclamation funds for public-safety hazard remediation, has been able to eliminate unsafe openings, highwalls and structures at over 1,500 of the most prominent sites. Based on analysis of pre-field and field data for these 6,000 AML sites, 275 sites have been identified as significant environmental-problem sites. A preliminary surface ownership analysis by the BLM indicates that 50 of those 275 environmental-hazard sites are on or affect the BLM surface estate. Of the identified environmental problems, acid and heavy-metals drainage were the most common causes of contamination.

A more recent inventory, conducted by the MBMG, focused on disturbed BLM and USFS lands within the State. To facilitate the preparation of this inventory, the BLM-Montana funded (\$305,000) that portion of the project cost associated with lands administered by the BLM. The USFS Region 1's field inventory form was adopted to standardize the data collection effort. Field data is currently being retrofitted to be compatible with the BLM national AML data base. The MBMG preliminary data search identified 1,016 probable AML sites on or near BLM-administered lands. Of those, 680 sites were visited by field scientists. The field reconnaissance component of this effort identified safety hazards on 88 AML sites. The most prevalent type of safety hazards were unrestricted mine openings such as open shafts and adits. In addition, 63 of the 680 sites were identified as having potential environmental problems affecting BLM-managed lands. The most prevalent type of environmental problem was streamside mining waste or tailings. A correlation between these 63 environmental sites and the 50 environmental-hazard sites identified by the Department of State Lands, Abandoned Mine Reclamation Bureau will not be conducted until BLM receives the MBMG data base and, thus, the extent of duplication is unknown at present.

Although both inventories have been completed, it is expected that over time more sites will be identified as more field work is completed. It is estimated, however, that 95 percent of all the significant sites have already been identified. The BLM will undertake additional site characterization efforts on a case-by-case basis. To date, four AML sites on BLM-administered lands have been remediated using tailings removal and containment, control of surface runoff, and revegetation. In 1996, the State, using coal reclamation funds, is attempting to clean up three moderately-complex environmental-hazard sites on Federal lands. All three sites (one BLM and two USFS) involve mixed (Federal/private) surface ownership.

The BLM has the interdepartmental lead for coordinating the AML Watershed Initiative Pilot in Montana. Priority watersheds for AML remediation were selected with input from the DEQ, Abandoned Mine Reclamation (AMRB) and Water Quality Bureau, MBMG, USFS, and USGS. Remediation efforts are underway in all priority watersheds as well as at several locations high on the AMRB priority list. State and Federal land managers are cooperatively addressing AML impacts at all of these locations. In addition, BLM remediation plans are being developed at several sites within priority watersheds in preparation of receiving fiscal year 1997 funding for this watershed pilot initiative. The USGS and Montana Department of Fish, Wildlife and Parks are assisting with monitoring and site characterization.



Figure 13. *Certain abandoned mine features, such as this shaft headframe, may be inviting for the public to investigate but can be a deadly hazard.*

Nevada

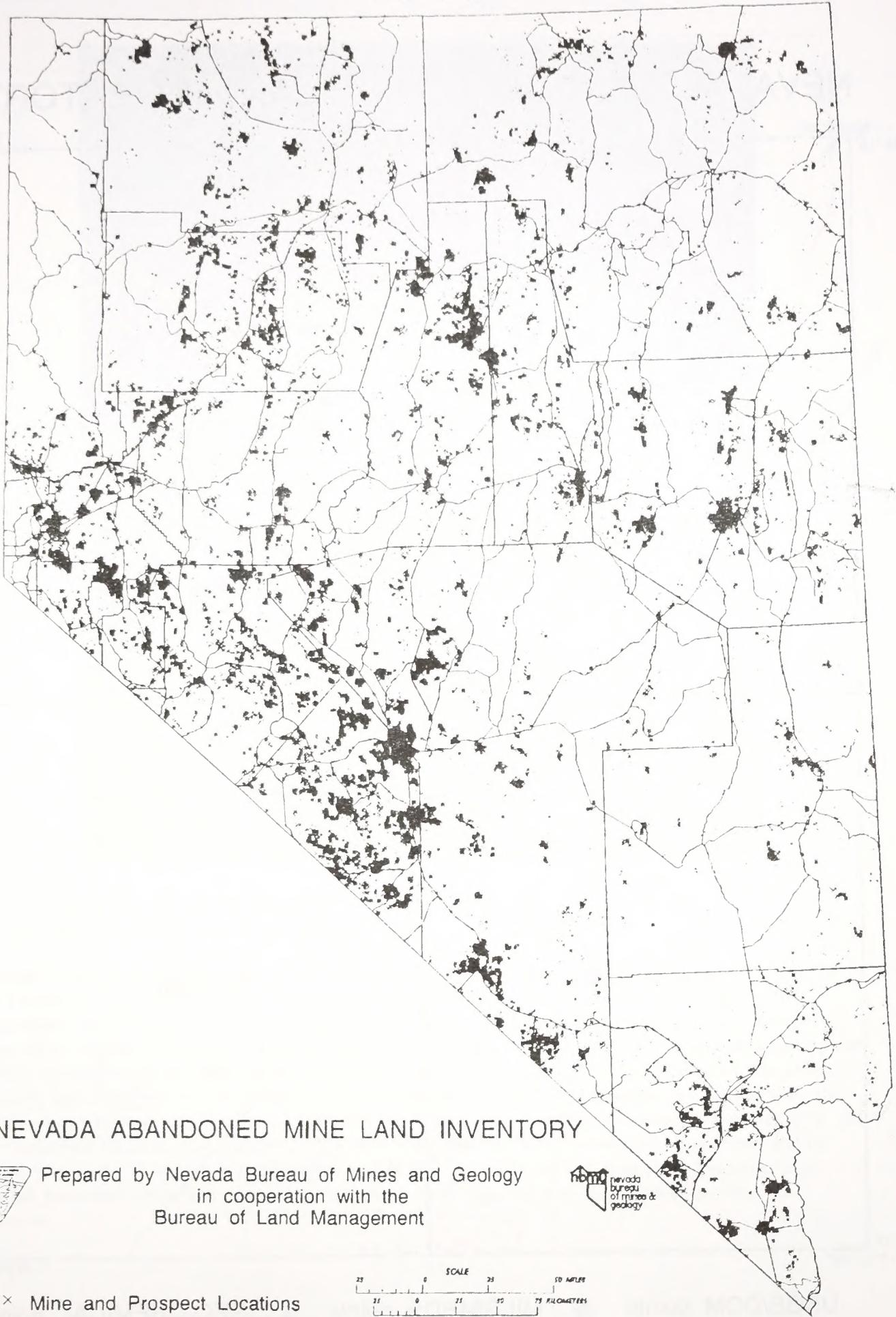
BLM-Nevada has been aggressive in addressing its AML inventory needs. Since 1992, Nevada has participated in four separate, but related, AML inventory efforts. These efforts involved a number of other Federal and State agencies, and the Paiute Indian Tribe.

State of Nevada Location Overlays - In 1994, BLM entered into a cooperative agreement with the Nevada Bureau of Mines and Geology to develop overlays for the location of all mineral activity features known to exist within the State. Mining feature locations on over 1,900 7.5' quadrangle maps were digitized and entered into a GIS data base. This pre-field assessment included a review of all major data sources covering mineral resources and mineral activities in the State, including the data bases supported by the USBM, USGS, Nevada Bureau of Mines and Geology, and Nevada Division of Minerals. Based on these existing data sources, the Nevada Bureau of Mines and Geology identified over 102,000 abandoned-mine features within the State. Figure 14 presents the location of the mines and prospects identified within the State. Figure 15 shows the concentration of points, by data source, near the town of Tonopah. An estimated 73 percent of the identified features are on public lands administered by the BLM. An additional six-and-a-half percent are located on lands administered by the USFS, and approximately 17 percent are located on private land. Many of these features located on private lands are in close proximity to, or completely encompassed, by public lands. Based on the pre-field investigations, including the work done by the State, and the recent field experience, BLM-Nevada estimates there are 165,000 features on BLM-administered lands. Of these estimated features, 32 percent (52,800 features) are likely to be significant or potential hazards.

Humboldt River Basin Field Inventory - Also in 1994, the BLM initiated a pilot on-the-ground investigation of public lands within the River Basin. The investigations were conducted by seasonal personnel that were trained in the use of GPS and GIS equipment, hazardous materials awareness, basic mine safety, and mine feature identification techniques. For the 2 years of field investigation (1994 and 1995), 2,079,553 acres of public land were inventoried. The investigation teams visited 313 sites, covering 127,293 acres. The field investigation found 8,820 features, over twice the number located on the 7.5' quadrangles. Of these, 2,848 or 32% were deemed to be significant using BLM-Nevada's cutoff criteria. The location of these significant features were documented using GPS. The 2,848 significant features include 1,007 adits, 666 shafts and 112 open pits. These adits, shafts and pits represent the most significant safety hazards. Some of these safety hazards have already been fenced by industry and the State. The most significant potential environmental hazards identified include 63 tailings, 24 leach sites, 5 sites with acidic water (pH<5.0), and 7 sites with large amounts of sulfides. No characterization or remediation efforts have been undertaken for any of these potential environmental-hazard sites.

Due to current budgetary constraints in 1996, further field inventory investigations have been constrained; limited to a single two-person crew in the field 2 days a week during the field season. BLM has a memorandum of understanding with the State, Division of Minerals regarding remediation. In 1995, 158 abandoned mine-safety hazards were remediated by fencing and other methods. As of November 1, 1996, the State had fenced another 201 mine openings.

FIGURE 14



NEVADA ABANDONED MINE LAND INVENTORY



Prepared by Nevada Bureau of Mines and Geology
in cooperation with the
Bureau of Land Management



× Mine and Prospect Locations

SCALE
25 0 25
11 0 11 75 75
50 MILES
75 KILOMETRES

NEVADA ABANDONED MINE LAND INVENTORY

FIGURE 15



38°00'

117°22'30"

38°00'

117°07'30"

USGS/DOM points

● MILS/MRDS points

▲ GEO-CHEMICAL points

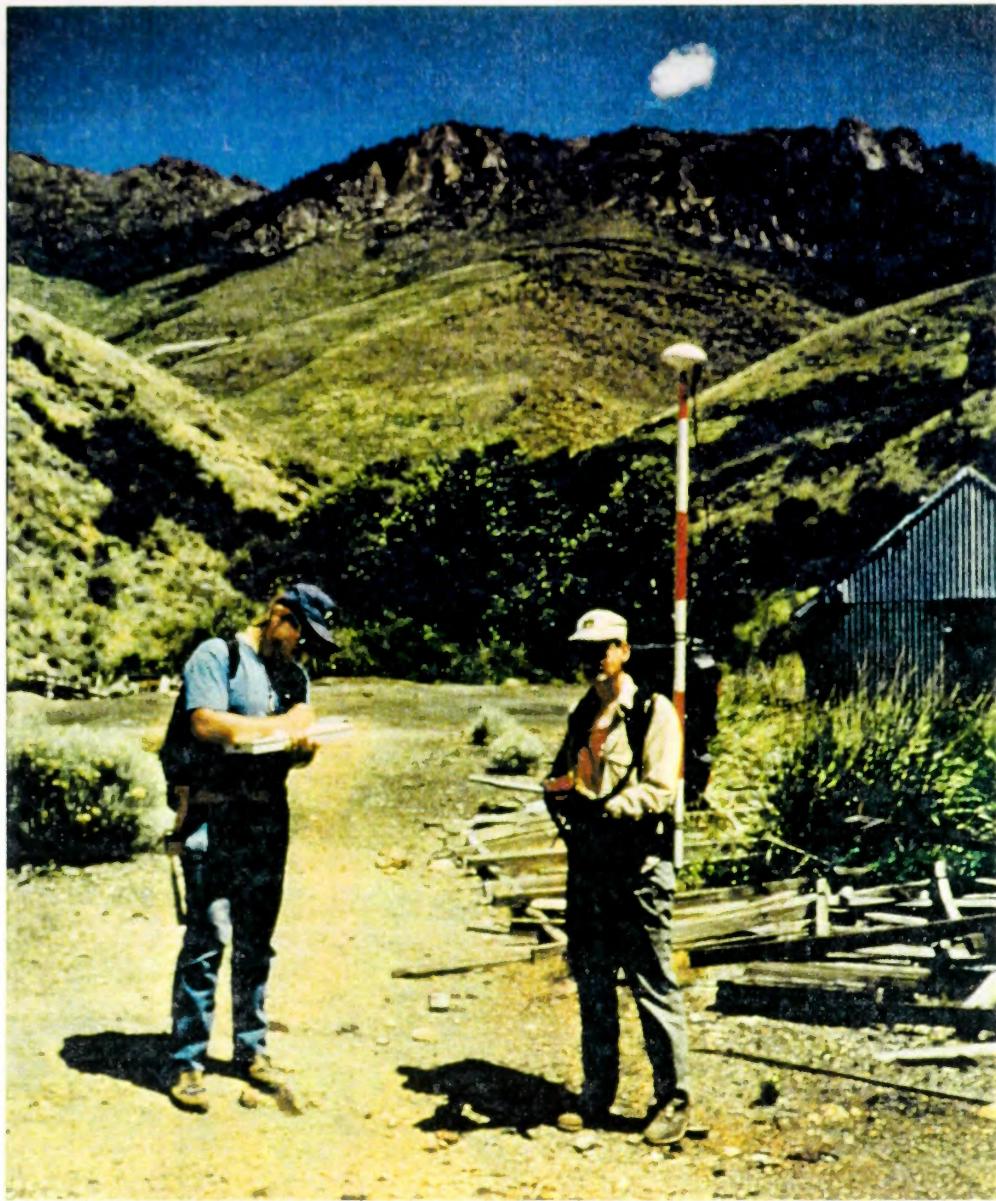
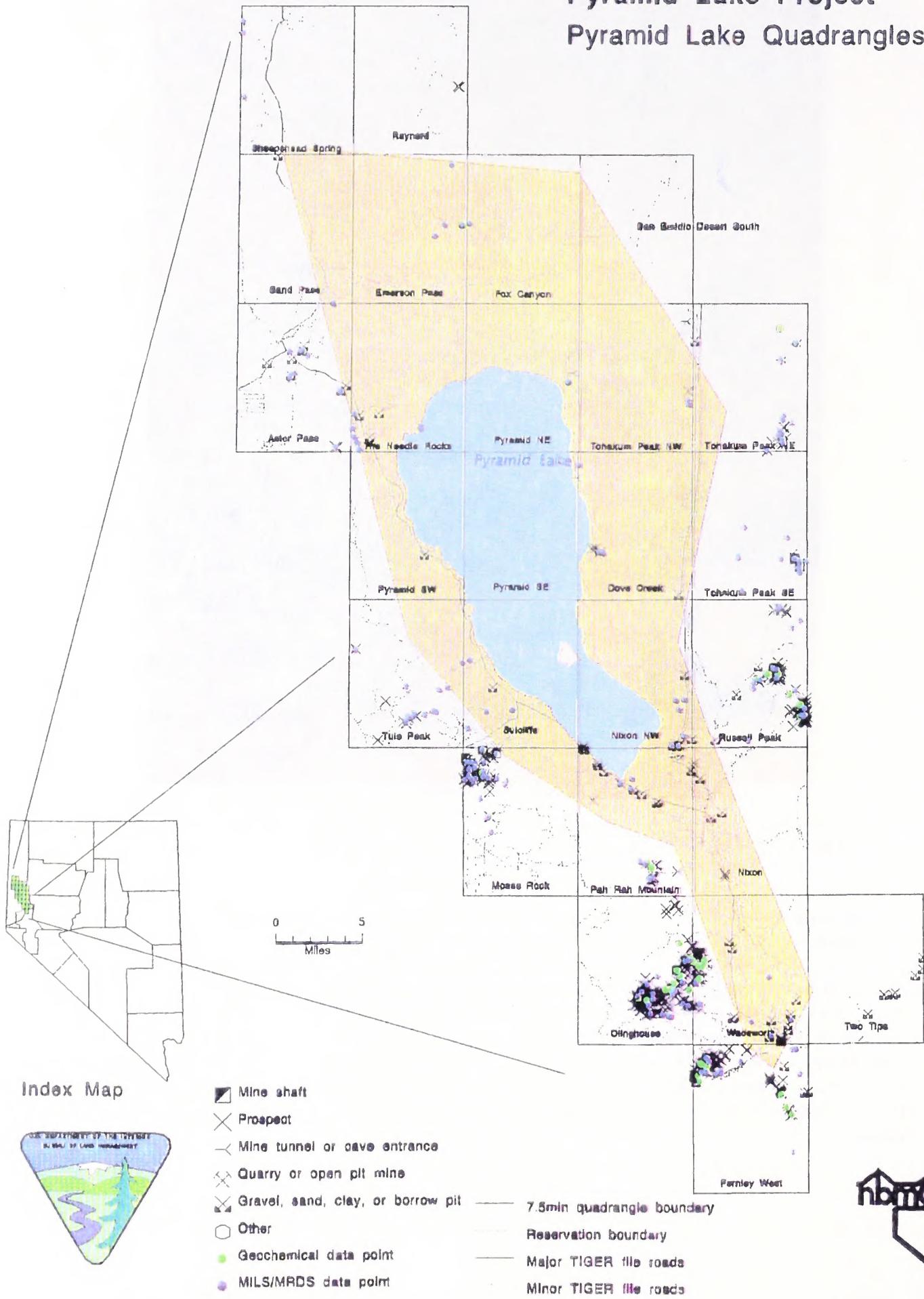


Figure 16. *The application of GPS technology greatly enhanced field crews' ability to identify and locate surface features.*

Pyramid Lake Indian Reservation - As part of the larger AML effort within the State of Nevada, the BLM offered to inventory Paiute Tribal lands within the Pyramid Lake Indian Reservation. In September 1994, following endorsement from the Tribal Elders, the BLM conducted the inventory. The effort included a review of existing documents, data bases, charts and information provided by the Tribal Geologist, an overflight of the Reservation, and 18 days of field work. The BLM was able to identify and verify (locations documented using GPS technology) 21 abandoned mine sites, with 182 mine-related features (see Figure 17, "Abandoned Mine Lands Inventory - Pyramid Lake Project"). Of the identified features, 124 features (68%) were identified as having possible environmental and/or safety concerns. However, it is important to note that the BLM did not attempt to determine any formal hazardous definition or ranking, but rather simply located and documented the sites and features.

FIGURE 17

ABANDONED MINE LANDS INVENTORY

Pyramid Lake Project -
Pyramid Lake Quadrangles

Winnemucca Environmental Hazard Ranking - In the fall of 1992, the Winnemucca District Office entered into a cooperative agreement with the USBM to field-verify a pre-field inactive and abandoned mine-hazard prioritization methodology for the identification of potential environmental-hazard sites. In 1991-1992, the USBM had developed the pre-field methodology to prioritize AML sites based on their potential for releasing chemical hazards into the environment. The idea of the methodology was to be able to identify the highest potential chemical-hazard sites based on literature and data-base searches. To test the accuracy of the methodology, BLM and USBM personnel conducted extensive field investigations of inactive and abandoned sites in the Winnemucca District. Based on observations of the actual site conditions, the methodology was then modified to improve its predictive ability. The tested methodology model appears to be a fairly accurate predictive model for the identification of potential chemical-hazard sites in this tested environment. However, the process provides little useful information in the identification of safety hazards, which is a far more serious concern in the arid Great Basin.

Within the Winnemucca study area, 1,295 sites were identified and ranked using available pre-field data and prioritization methodology. Of the identified sites, 43 sites were ranked as having environmental (chemical)-hazard potential. As part of the field-verification phase of the pilot project, 273 (potential, no-potential and undetermined) sites were visited. Preliminary results of the field work verified that the potential chemical-hazard sites were appropriately identified using the pre-field ranking. More complete correlation of field data with the pre-field rankings, along with proposed site-characterization work, was forgone with the elimination of the USBM in early 1996.

New Mexico

In response to the requirements of SMCRA, the State established the New Mexico Abandoned Mine Land Bureau to administer the identification and reclamation of AML sites in the State. A formal AML inventory of lands in New Mexico was initiated in 1979 by the State and BLM. The focus was on coal mines and secondarily on uranium mines. Approximately 500 sites with an estimated 5,000 features were inventoried. However, no systematic approach or single comprehensive data base has been developed for these inventories. In addition, past inventoried data did not specify surface ownership. Within the last several years, the State has initiated efforts aimed at the identification and reclamation of inactive and abandoned hardrock mines.

BLM-New Mexico's inventory effort started in 1991. Pre-field efforts include a review of all literature, data bases and topographic maps for all BLM-administered lands within the State. Due to funding and personnel limitations, current field inventories are occurring only on those high public-exposure areas that pose a clear and obvious public-safety hazard. Field work, covering approximately 248 square miles, has verified 523 AML sites, with approximately 1,000 associated safety-hazard features and five potential environmental hazards. Field results are identifying many more sites/features on the ground than can be found in the existing literature, data bases and maps. Existing data bases were found to be unreliable for locating AML sites and features. Publications on mining areas and USGS topographic maps are the most useful pre-field data source. Based on the available data, BLM-New Mexico estimates there are 3,000 AML sites, with 6,500 associated features on lands administered by the BLM in the State.

BLM-New Mexico's field work employed two approaches. The first field inventories, 1991-1993, were reconnaissance in nature, involving the investigation of a relatively few sites over a large geographic area. These efforts identified 282 sites in a 228-square-mile area. Because of the approach taken, it is considered the number of sites verified are a very small percentage of the actual number of sites in the inventory area.

The latest inventory effort was initiated in 1995. These inventories are far more field-intensive, involving a large number of sites in a relatively small high-risk area. The three areas currently being inventoried are the Cerrillos, Lake Valley and Orogrande Mining Districts. These inventory areas were considered to be high-risk areas due to their proximity to population centers, high-recreational use and/or other factors. To date, 241 sites have been verified in an approximately 20-square-mile area. Given the field-verification approach employed, it is expected this inventory reflects close to 100 percent of all sites/features within the inventoried area.

AML safety hazards in New Mexico consist mainly of open shafts, adits, and unstable structures and ground. Environmental hazards at AML sites are minimal, and are mainly related to erosion and sedimentation of disturbed lands. No AML sites with water-related environmental hazards, such as acid-rock drainage, have been identified in BLM's field work to date.

The State has successfully reclaimed almost all high-risk/high-visibility coal and uranium AML sites within New Mexico. As with the inventory effort, the State's recent reclamation efforts are focused on the contracting of mainly hardrock-mine-site reclamation. To date, the State Abandoned Mine Land Bureau has remediated an estimated 150 hazardous mining features on BLM-administered lands.

Closure techniques on these safety hazards have included backfilling, cable net, grates, fencing and blasting. In addition to the State's efforts, the BLM has temporarily fenced 10 features that posed safety hazards. The State estimates closure costs average \$6,000 per feature, ranging from \$1,000 for backfill to \$12,000 for polyurethane-foam fill.

For 1996, BLM-New Mexico completed its inventory in the Lake Valley and Orogrande areas, and continued the effort in Cerrillos. In addition, BLM continued its long-term commitment to work with the Abandoned Mine Land Bureau in developing remediation contracts of high-risk features in the Lake Valley area.

An additional cooperative effort the BLM has with the State involves the management of historic and cultural resources within the historic Lake Valley Mining District. This mining district contains mine features and structures on BLM land, including an old school house. The resource management plan identifies these as valuable cultural resources to be managed in collaboration with the State. The plan specifically identifies the remediation of hazards and the preservation of the historic and cultural resource values.

Oregon

In 1995, BLM-Oregon/Washington initiated an intense pre-field effort to locate AML sites on BLM-administered lands. Based on existing county, State and Federal data sources, the Oregon State Office and Spokane District Office plotted points on 7.5' USGS quadrangles for all probable AML sites for the two States. Each District Office was provided with maps, field data forms and instructions to initiate a districtwide AML inventory. In addition, the Spokane, Eugene, Roseburg, Vale, Lakeview and Medford Districts completed subsequent literature searches to more accurately define likely AML sites. Based on this pre-field review and already-completed field work, it is estimated there are approximately 3,400 AML sites in Oregon and Washington on public lands administered by the BLM.

To date, field investigations of approximately 200 acres have located and characterized 206 AML sites. The field inventory identified 25 potentially hazardous features on those 206 sites. These hazards include 10 public-safety hazards and 15 potential environmental hazards.

Due to a lack of funding, remediation has been limited to just one site in the Medford District. Surface water quality was being adversely impacted by this site. The District remediation effort included reestablishing drainage and revegetation, at a cost of \$3,500 paid by damaged lands funds. In addition, the Medford District has identified a site that has a major acid-rock-drainage problem. The District Office has been working closely with the Oregon Department of Environmental Quality and Oregon Department of Geology and Mineral Industry on this particular problem.

For 1996, budget and personnel limitations limited any significant progress in the inventory and remediation of AML hazards. The Spokane District completed its pre-field investigation, including a full literature search of all sites identified in 1995 and prepared of field maps for sites to be investigated in the future. The Roseburg District visited 28 priority sites. Lakeview completed about one-third of its preliminary inventory in 1996. The other Districts made little, if any, progress towards the completion of their AML inventory.

Utah

In recognition of a long-term need, BLM-Utah began development of an AML inventory methodology in the fall of 1991. By the summer of 1993, Utah had initiated an AML inventory pilot project to develop techniques to identify as many sites as possible economically. The pilot project area was composed of four mining districts located in southeastern Utah within the San Juan Resource Area. The mining districts and their corresponding priority for inventory were (1) Cottonwood Wash, (2) White Canyon, (3) Fry Canyon, and (4) Red Canyon. These mining districts comprise 230,759 acres.



Figure 18. *Many AML features can be found surrounded by great expanses of undisturbed lands.*

Utah used a comprehensive preliminary and field approach in the identification and verification of AML sites. The preliminary or pre-field work used the remote sensing techniques of satellite imagery, airborne videography and aerial photography to identify potential areas of disturbance. Additional pre-field research included reviewing the Utah Mining District Areas and Principle Metal Occurrences Map, USGS topographic maps, literature on the mining districts, Utah Geological Survey's Utah Mineral Occurrence System (UMOS) data base, Abandoned Mine Reclamation Program's (AMRP) AML data base, USBM's MILS data base, and BLM's Case Recordation System. The BLM field investigation identified the following major mine features at 124 sites within the pilot project area: 177 open and 15 closed adits, inclines, and shafts, 20 open pits, 228 waste dumps, 83 trenches and prospects, 211 open drill holes, 1 mill, and 164 transformers, petrochemical products, barrel/tanks and dumps, as well as 17 sites with explosives. (As of October 1, 1996, verification of electronic data had not been completed.)



Figure 19. With the shift in emphasis from inventory to remediation, the recommended strategy will allow the BLM to more actively address public-safety hazards.

The pilot project provided a wealth of information concerning the usefulness of the various pre-field and field techniques used. Although the various pre-field data sources (maps, literature searches, data base searches, and remote sensing) provided useful information, none of these sources are an adequate substitute for field investigations. For example, for the Cottonwood Wash mining district, UMOS identified 26 sites, and MILS identified 38 sites. BLM field investigation identified 61 AML sites. These 61 sites contained 103 adits, 4 shafts, 10 open pits, 158 waste dumps, and various other features.

BLM-Utah determined that videography was not currently cost effective due to the intense post-processing. Aerial photography requires development of additional criteria to make mine-site identification more accurate. In addition, the geologic data for an area should be scanned as a vector file and overlain on the imagery in order to allow specific mineral-producing formations to be identified and extracted as "highest-potential" areas for AML sites. Geologic areas that are not likely candidates for mining would be filtered out of the analysis procedure, increasing the efficiency of the interpretation process. One of the most important advances that improves the efficiency and accuracy of field work is the utilization of GPS and GIS technologies. These tools greatly enhanced the speed and reliability of the field reconnaissance.

During the summer of 1995, the inventory of Temple Mountain mining district was also completed. The Temple Mountain mining district encumbers 15,236 acres in eastern Utah. The major mining features at the 23 AML sites in this district include: 75 open adits and inclines, 28 open shafts, 51 waste dumps, 29 prospects, 4 trenches, 117 open drill holes, 1 mill, and 20 barrel/tank and other dump sites. (The review of the electronic records was not completed as of October 1, 1996.) In 1996, BLM used seasonal employees to work with the State AMRP seasonal employees to inventory the Fivemile Pass mining district. As in the past, the State and BLM teams received comprehensive training addressing inventory practices and procedures, mine safety, and hazardous material awareness.

BLM plans to test a ground-based spectrometer, which gathers specific spectral data, at previously-visited sites to identify any unique signatures associated with the mine commodities, such as uranium. These signatures will be related back to the Landsat and multispectral video in a "multi-tiered" approach to provide input for a supervised classification of the imagery. If a correlation does indeed exist, it is hoped that the spectral data can be used for other areas to locate those same commodities and serve as a filter in location/classification of sites throughout the State.

BLM has developed a working partnership with the Utah AMRP to address AML. BLM-Utah will identify top-priority safety hazards which will then be considered for remediation by the State. The State program has primarily focused on the identification and correction (i.e., fencing and closure) of safety hazards at coal, and then non-coal, AML sites. Due to funding limitations, the State is not able to address environmental hazards at AML sites.

Wyoming

BLM-Wyoming has been a long-term partner with the State of Wyoming in the identification and reclamation of AML sites. In 1984, BLM signed a cooperative agreement with the State to facilitate the identification of AML sites on public lands. In addition to this early start, Wyoming has benefited from the availability of SMCRA funds through the State's AML program to inventory and reclaim abandoned mine sites. For 1995, the State AML program had approximately \$20 million available for the identification and reclamation of abandoned mine lands as well as for public works projects in impacted communities. However, a limitation to this ongoing effort is that the focus of the State program has been on public safety with less attention paid to environmental hazards and watershed concerns.

In the early 1980s, the State established its AML program under the Wyoming Department of Environmental Quality in response to the requirements of SMCRA. As part of the learning process, a combination of different procedures were simultaneously applied to locate hazardous sites within the State. The inventory procedures included: aerial photography, nominations by the public and land management agencies, data searches, and site investigations. Aerial photography was found to be only moderately accurate for certain areas. However, the cost of the aerial survey was about \$600,000, or about 40 percent of the total initial inventory budget. Data searches, primarily the Geological Survey of Wyoming, Wyoming State Mine Inspector files, and the public and land management agencies nomination system were found to be a very accurate and cost-effective tool for locating potentially hazardous inactive and abandoned mine sites. Wyoming's experience suggests that the most successful methodologies are these relatively "low-tech" approaches.

The nomination system has provided Wyoming with a successful approach to meeting its AML inventory needs. Since 1985, each of the BLM Districts have been submitting identified AML sites on an as-needed basis for consideration by the State.

To date, the State AML program, in conjunction with private land owners, other State agencies, and Federal land managers, has identified over 2,000 potential AML sites through various inventory methods; field checking revealed that about 800 of these were in need of reclamation under the State AML program. These numbers include all land in the State, regardless of ownership. However, past inventories of BLM lands were not as extensive as those conducted on other lands. Discussions with State AML personnel indicate that a rough estimate of 2,000 AML sites on BLM-managed lands in the State might be "within the ballpark." Each of these sites may contain an average of four features, for a total estimate of 8,000 features. These feature numbers do not include approximately 150,000 plugged drill holes. Due to the existence of such a well-established and well-funded State program, BLM-Wyoming's efforts to systematically inventory AML lands have been given a low priority. BLM-Wyoming has focused on working with the State to remediate known sites.

To test the completeness of the existing AML inventories on BLM-administered lands and test a proposed watershed-based AML screening process for setting priorities for reclamation, BLM began a focused pilot inventory effort in 1995. This effort covers the South Pass/Atlantic City historic mining district, located south of Lander, Wyoming. Pre-field inventory work has been initiated for the entire study area, including: a review of color-infrared aerial photographs (1:40,000 scale), USBM MILS printouts, USGS MRDS files, State AML Site Inventory sheets and Wyoming State Geological Survey maps (1:24,000 scale).

In 1995, an interdisciplinary team was formed to incorporate watershed concepts into BLM-Wyoming's more traditional AML activities. Based on expanded management guidance, the South Pass/Atlantic City pilot project evolved from a mining-district-based inventory to a watershed-based project. Initial contacts have been made to bring other Federal and State agencies into what will be a multiagency cooperative effort. In addition, the study area may be redefined to encompass the 500-square-mile upper watershed of the Sweetwater River or to focus on one of its tributaries.

Progress on the field work component of the pilot has been delayed due to a lack of funding. To date, six square miles have been inventoried and four safety/environmental-hazards sites have been identified. These four sites include a number of pits and shafts which pose safety hazards and pits that are being used for the dumping of trash. If funds are available, more extensive field inventorying will be scheduled for the 1997 field season. The intent is that an expanded field effort will be able to provide a more comprehensive investigation of the resource values within the watershed.

With the early start, availability of coal reclamation funds, and extensive interagency coordination, the BLM and State have been able to focus attention on remediation and reclamation. Through calendar year 1994, the State AML program had been able to reclaim a number of problem AML sites/features. As with the inventory efforts, the State's emphasis has been on public-safety hazards, with less work done to remediate environmental-hazard sites. Of AML sites reclaimed to date in Wyoming under the SMCRA program, approximately 32% are coal, 18% are hardrock, 40% are bentonite, and 10% are uranium.

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Appendix 3

AML INVENTORY AND CHARACTERIZATION FUNDING⁶⁷
1994, 1995 and 1996

State	Total
ALASKA ⁸	
ARIZONA	\$300,000
CALIFORNIA	\$87,000
COLORADO	\$320,000
IDAHO	\$33,000
MONTANA	\$320,000
NEVADA	\$261,000
NEW MEXICO	\$41,000
OREGON	\$160,000
UTAH	\$237,000
WYOMING	\$105,000
TOTAL	\$1,849,000

⁶ Includes some costs associated with remediation of safety hazards. Several BLM State Offices entered into agreements with State Agencies whereby the State abates safety hazards identified by the BLM.

⁷ Includes Hazmat funds used for AML inventory and characterization. Does not include costs for hazardous materials cleanup at mine sites on public lands.

⁸ All AML inventory activity conducted in Alaska has been in conjunction with on-going Surface Management responsibilities. As such, for the period 1994 through 1996, no funds were specifically allocated for the purpose of conducting an AML inventory.

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Illustration by Shelly Fischman

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